	L #	Hits	Search Text	DBs
1	L1	1	59033787$3	USPAT; US-PGPUB; EPO; JPO; DERWENT
2	L2	109	coreless near5 transform$3	USPAT; US-PGPUB; EPO; JPO; DERWENT
3	L3	319	219/619.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT
4	L4	2	2 and 3	USPAT; US-PGPUB; EPO; JPO; DERWENT
5	L5	10335	399/328-355.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT
6	L6	1	2 and 5	USPAT; US-PGPUB; EPO; JPO; DERWENT

	L #	Hits	Search Text	DBs
7	L7	28647	core$3 near5 transform$3	USPAT; US-PGPUB; EPO; JPO; DERWENT
8	L8	38	3 and 7	USPAT; US-PGPUB; EPO; JPO; DERWENT
9	L9	30	5 and 7 not 8	USPAT; US-PGPUB; EPO; JPO; DERWENT
10	L10	6799	219/600-677.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT
11	L11	4	2 and 10	USPAT; US-PGPUB; EPO; JPO; DERWENT
12	L12	5	roll$3 same 2	USPAT; US-PGPUB; EPO; JPO; DERWENT

US-PAT-NO: 5216215

DOCUMENT-IDENTIFIER: US 5216215 A

TITLE: Electrically powered fluid heater including a **coreless transformer** and an electrically conductive jacket

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Abstract Text - ABTX (1):

A main-frequency electrically powered fluid heater which includes a **coreless transformer** and an electrically conductive jacket through which flows the fluid to be heated; the **coreless transformer** comprises a primary winding electrically insulated from the jacket but at least partially surrounding it, and a secondary winding arranged so as to be linked by magnetic flux from the primary winding; secondary winding being electrically insulated from the primary winding, but electrically connected to the jacket, so that the jacket is heated both by resistance heating and by eddy current heating.

TITLE - TI (1):

Electrically powered fluid heater including a **coreless transformer** and an electrically conductive jacket

Brief Summary Text - BSTX (16):

It is a well-established principle in electrical engineering practice that for mains-frequency devices, efficient magnetic flux linkage is achieved only if a transformer core is used. **Coreless transformers** have been known and

halogen
lamp, has heretofore been employed to thermally fix toner image onto record medium. Such a technology encounters an issue such as a prolonged warm-up time
or an insufficient thermal capacity. To address this issue, considerable research and development work has been undertaken in the past to commercially
apply an induction heating technology.

[0003] Japanese Patent Publication NO. 2000-215974 discloses an excitation coil
located in close proximity to an object body to be heated for causing induction
current to flow through the object body, with the excitation coil including a coil wire material wound in a plane and deformed in a shape to cope with a curved wall of the object body while a magnetic core is located in a position opposed to the object body with respect to both ends of the excitation coil in a longitudinal direction thereof such that the magnetic core cope with a curved
surface of the excitation coil. (Related Art 1) Japanese Patent Publication NO. 2000-215971 discloses an induction heating device which includes a heating
rotor body having an electromagnetic induction heating property, and a magnetic
flux generating unit located inside the heating rotor body for generating magnetic flux of a high frequency to cause the heating rotor body to be heated up due to an electromagnetic induction heating for thereby heating the object body, with the magnetic flux generating unit including a core, made of magnetic
material, and an electromagnetic transducer coil wound around the magnetic core, which is comprised of a core portion around which the electromagnetic transducer coil is wound, and a magnetic flux induction core portion opposed between distal ends portions in a magnetic flux gap for concentrating a magnetic flux at a portion of the heating rotor body more intensively than that concentrated at the core portion. (Related Art 2)

[0004] Any one of the Related Arts 1 and 2 employs a heating technology

that
uses an eddy-current loss which provides the same effect commercially realized
in an IH cooker. A high frequency electric current to be utilized in such a heating technology is selected to have a frequency ranging from 20 to 100 kHz.

[0005] On the contrary, Japanese Patent Publication NO. 59-33787 discloses a
high frequency induction heating roller which is comprised of a cylindrical roller body composed of electrically conductive material, a cylindrical bobbin located inside the cylindrical roller body in a concentric relationship, and an induction coil wound around an outer circumferential periphery of the bobbin in
a spiral relationship to induce induction current in the roller body to compel it to be heated up. (Related Art 3)

[0006] With such a structure of the Related Art 3, the cylindrical roller body serves as a secondary coil of a closed circuit and the induction coil serves as a primary coil, with the primary and secondary coils being coupled in a transformer relationship to cause secondary voltage to be induced in the secondary coil of the cylindrical roller body. The presence of flow of secondary electric current through the closed circuit of the secondary coil responsive to the secondary voltage compels the cylindrical roller body to be heated up, i.e. in a so-called secondary side resistance heating technology. With this technology, the presence of stronger magnetic coupling than that achieved in the heating technology using the eddy-current loss increases a stationary efficiency while enabling the whole of the heating roller to be heated up, resulting in an advantage wherein a fixing device becomes more simple in structure than those of the Related Arts 1 and 2.

[0007] However, the Related Art 3 encounters an issue wherein a warm-up time
can not be so shortened as expected. Upon considerable research and study conducted by the inventor, such an issue is deemed to originate from the resistance value of the secondary coil formed in the heating roller, which is not supervised.

[0008] In the Related Art 3, further, with the use of such a low frequency ranging from 20 to 100 kHz that is obtained in an IGBT inverter that is used in
cooking equipments such as an induction heating type cooker or range, it is difficult for a high electric power transmitting efficiency to be obtained.

SUMMARY OF THE INVENTION

[0009] It is therefore an object of the present invention to provide an induction heating roller device and a heating roller for the induction heating roller device, and a fixing apparatus and an image forming apparatus, using such component parts, which are able to obtain a high electric power transmitting efficiency.

[0010] It is another object of the present invention to provide an induction heating roller device and a heating roller for the induction heating roller device wherein the heating roller has a temperature distribution as uniform as possible, a fixing apparatus and an image forming apparatus using such component parts.

[0011] According to a first aspect of the present invention, there is provided an induction heating roller device which comprises an induction coil unit having a primary coil, and a hollow heating roller having a secondary coil coupled to the primary coil of said induction coil unit through a coreless transformer coupling and having a secondary resistance value substantially equal to a secondary reactance, said heating roller being rotatably supported. Further, the secondary coil may be formed of a closed circuit.

[0012] The present invention will be described hereinafter in conjunction with terminologies based on the following definitions and technical meanings.

[0013] Induction Coil Device

[0014] The induction coil device is energized, i.e. excited with an alternating electric power supply and, more preferably, with a high frequency output of a high frequency electric power supply. Alternatively, the induction coil unit

is comprised of the primary coil which is coupled with the secondary coil of the heating roller through a core-less transformer coupling. The primary coil may be held stationary with respect to the rotating heating roller or may be rotated either together with the heating roller or separately from the same. Also, when it is desired to rotate the primary coil, a rotational current collecting mechanism may be located between the alternating current power supply and the induction coil unit. The "core-less transformer coupling" means
not only a complete core-less transformer coupling but also a transformer coupling which seems to remain in a substantially core-less relationship.

[0015] Further, the induction coil unit may be comprised of a coil bobbin for supporting the primary coil. The coil bobbin may be formed a winding recess for achieving well-ordered winding of the coil.

[0016] Furthermore, the induction coil unit allows the primary coil to be formed in a single coil component or in a plurality of coil components. In case of the primary coil composed of the single coil component, the primary coil may be located at a substantially central area of the heating roller. In case of the primary coil composed of the plurality of coil components, the plural coil components may be equidistantly distributed over the surface of the
heating coil along an axis thereof. And, respective primary coil components may be connected to the alternating current electric power supply in parallel to one another.

[0017] Heating Roller

[0018] The heating roller includes the secondary coil which is coupled with the
primary coil through the core-less transformer coupling. And, the closed circuit has the secondary resistance value which is substantially equal to the secondary reactance of the secondary coil. Further, the secondary coil may be
formed in a closed circuit. In this connection, an expression that the secondary resistance value and the secondary reactance are "substantially equal" to one another is meant by the fact that, when the secondary resistance